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(a)

s_{11}	s_{12}	...	s_{1N}

c_{11}
c_{12}
...
c_{1G}

$s_{11}c_{11}$	$s_{12}c_{11}$	...	$s_{1N}c_{11}$
$s_{11}c_{12}$	$s_{12}c_{12}$	...	$s_{1N}c_{12}$
...	...	...	...
$s_{11}c_{1G}$	$s_{12}c_{1G}$	...	$s_{1N}c_{1G}$

· Modulated data   After TP Spreading

(b)

Fig. 1: Block diagram for the transmitter of the proposed system
    (a) Transmitter structure
    (b) Data structure, before and after block spreading module
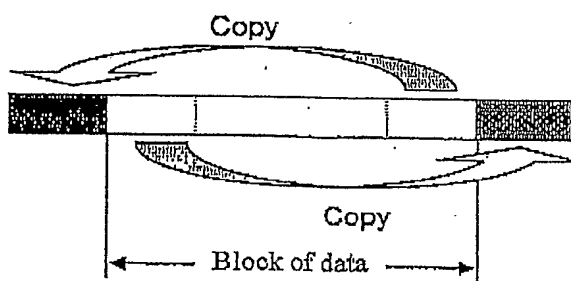

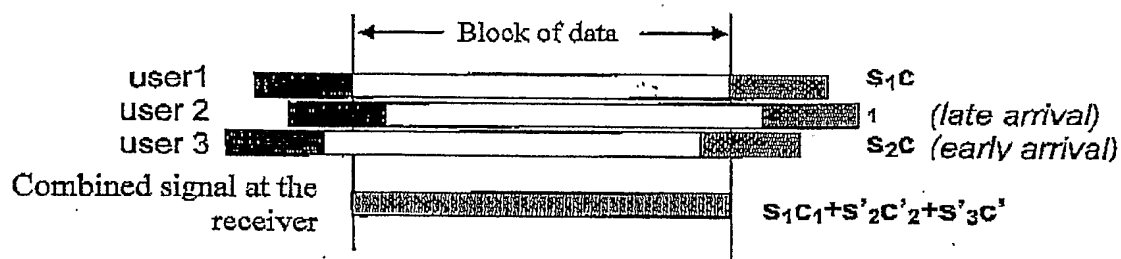Fig. 2: Details of insertion of cyclic extension

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Fig. 3: The combined received signal for cyclic extended asynchronous transmission for ideal channel
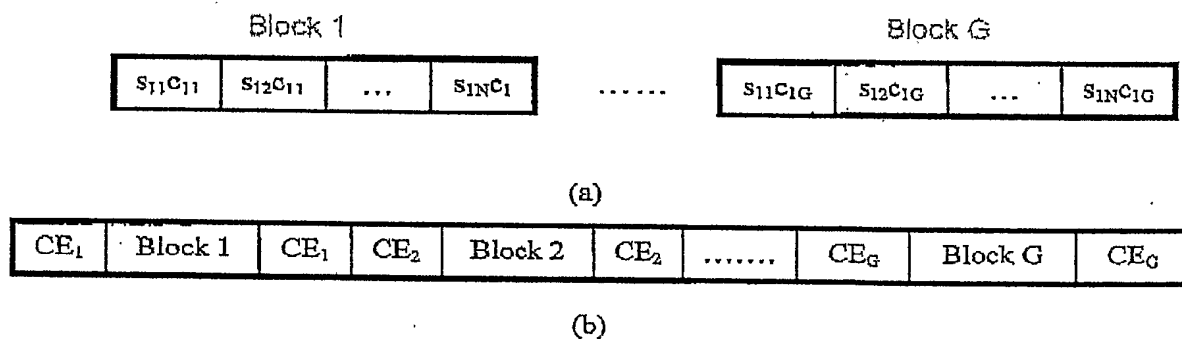

(a)

(b)

Fig. 4: The packet structure before and after the insertion of cyclic extension
(CE1 is cyclic prefix and CE2 is cyclic postfix)
(a) Block structure after parallel-to-serial conversion
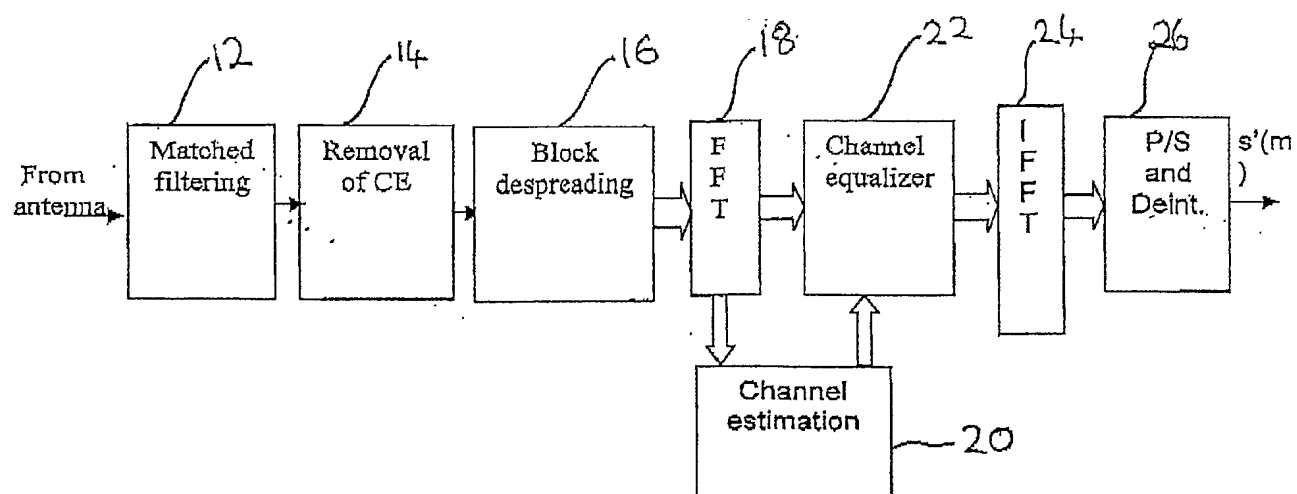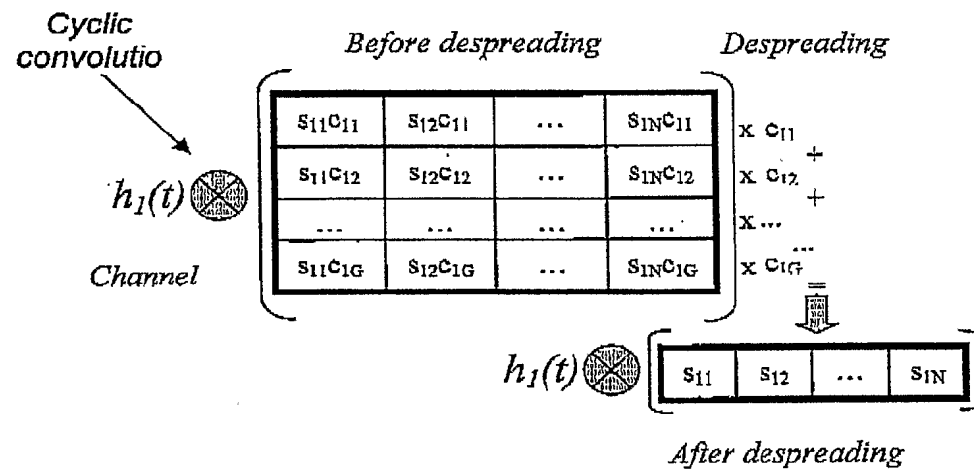(b) One TP spreading module after the insertion of cyclic prefix

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Fig. 5: Block diagram for the receiver of the proposed system

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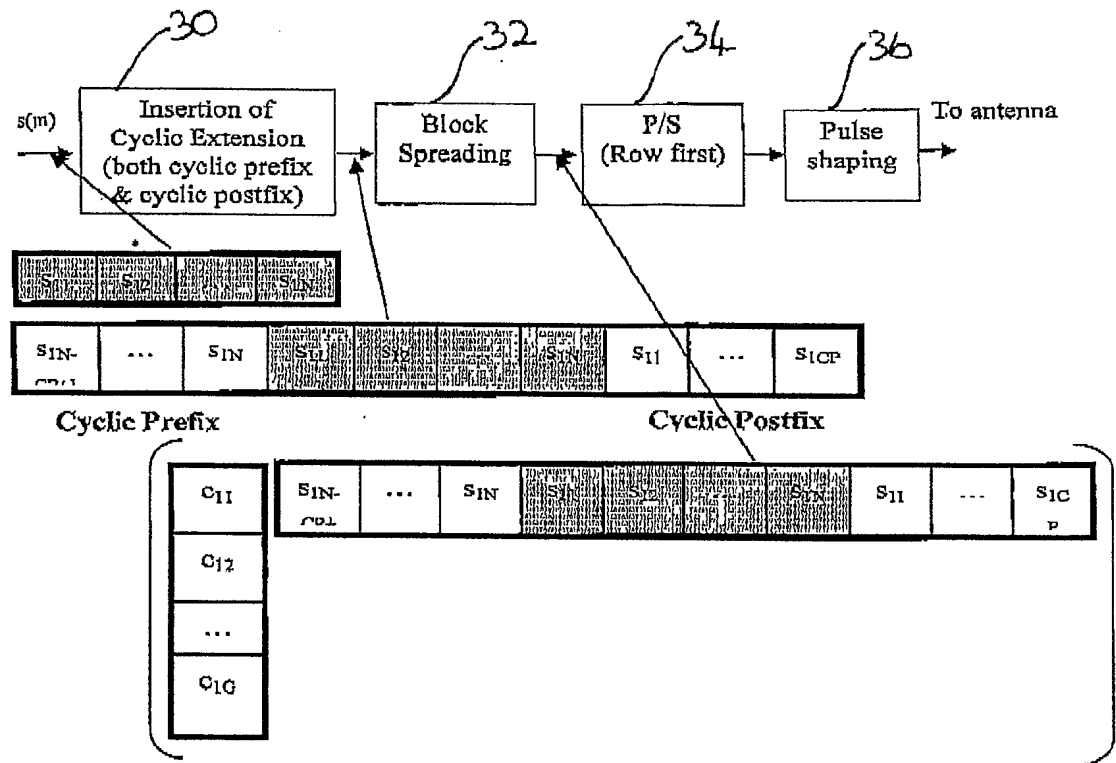Fig. 6: Details of block dispreading procedure for user 1

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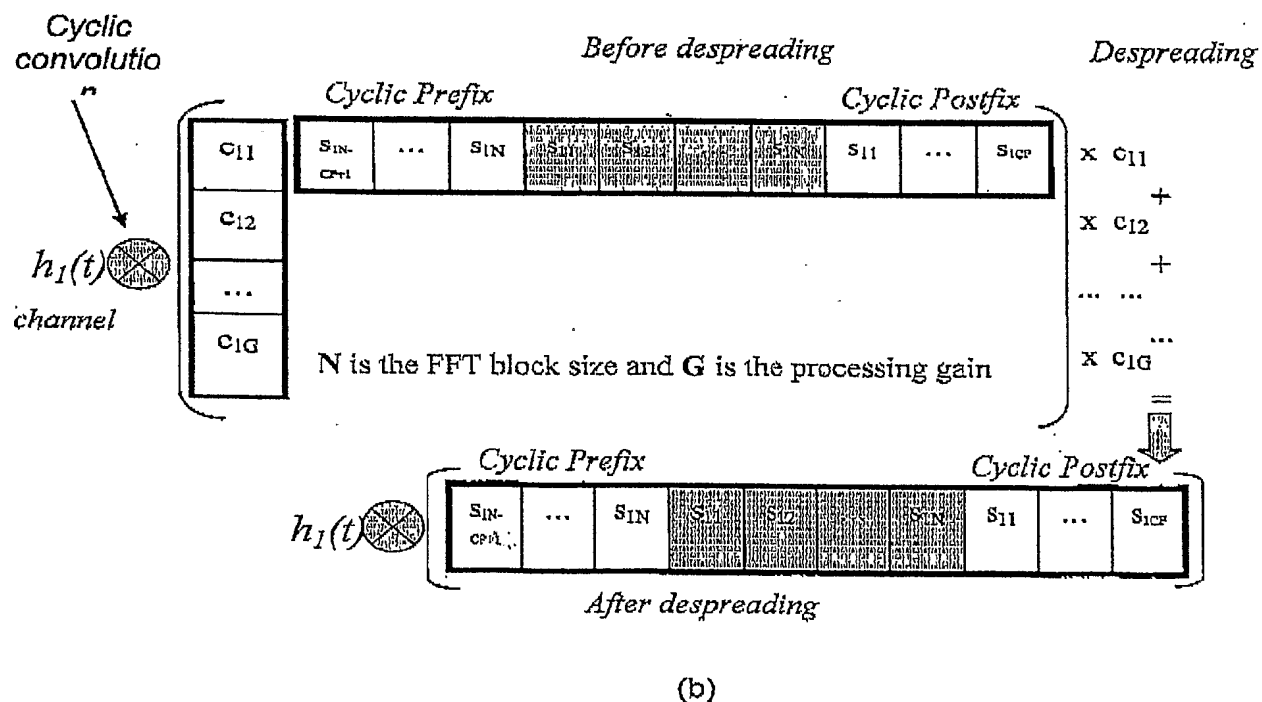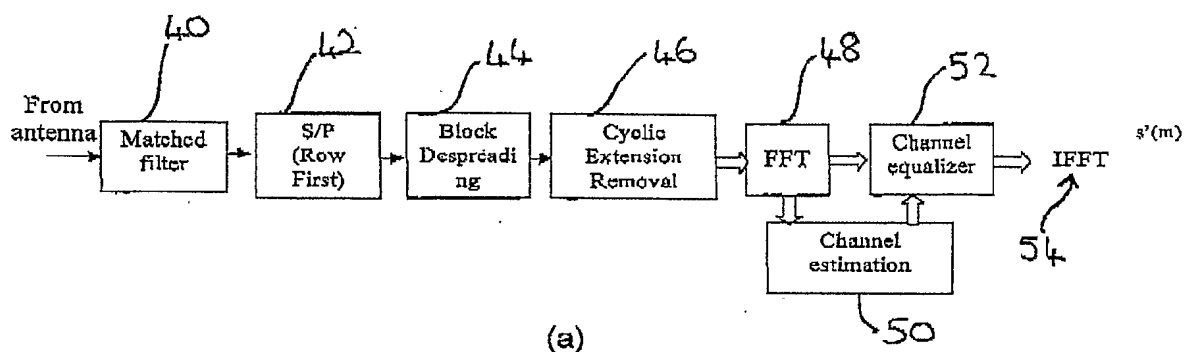
Fig. 7: Block diagram for the transmitter (Method 2)

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Fig. 8: Receiver structure for alternate method

   (a) Block diagram for the proposed receiver (alternate method)
   (b) Details of block dispreading procedure

(a)

N is the FFT block size and G is the processing gain

After dispreading

(b)

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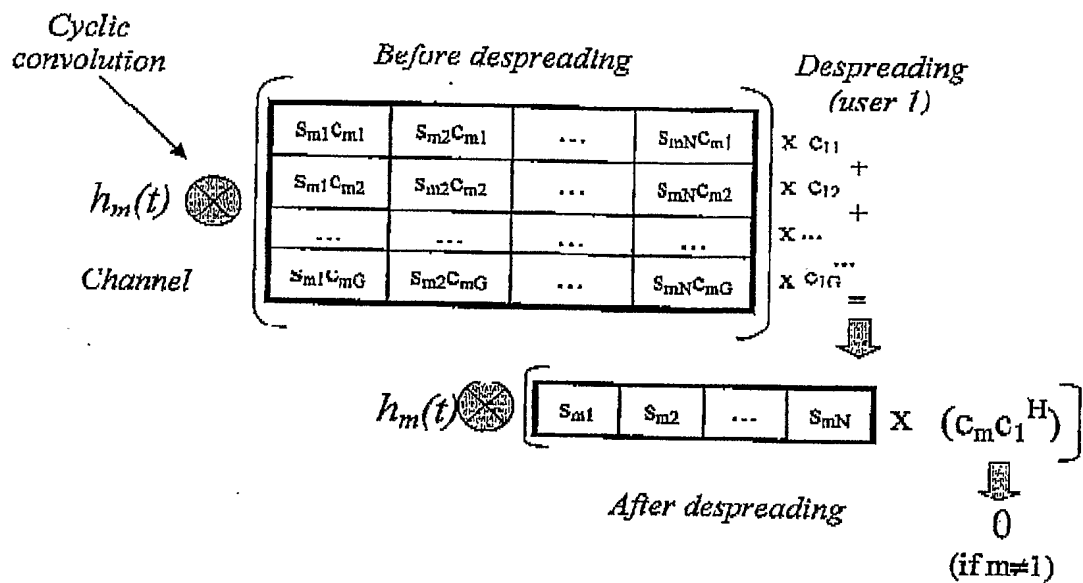

Fig. 9: Illustration on the effect of MAI for the proposed system
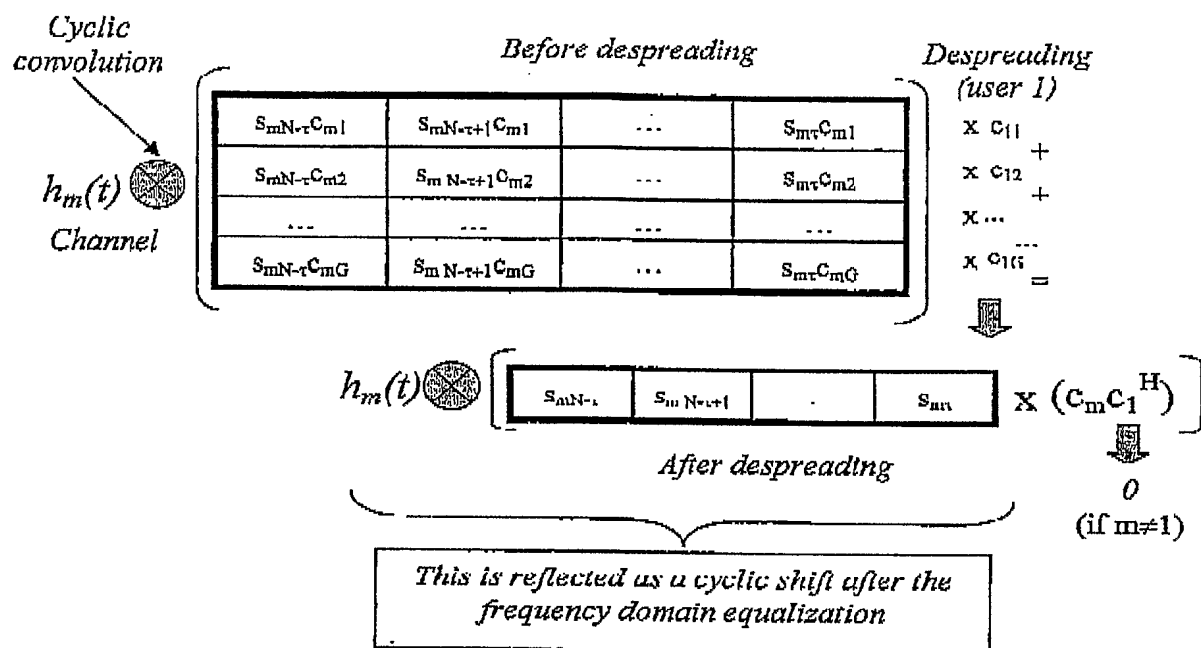
8|10

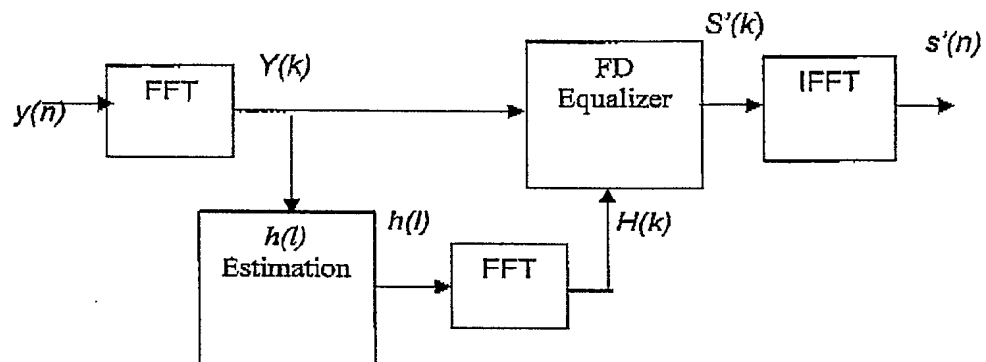Fig. 10: Illustration on the effect of MAI when the users are asynchronous

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Fig. 11: Block diagram for the time-domain channel response estimation and frequency domain equalization

10 | 10

T_r

T_p
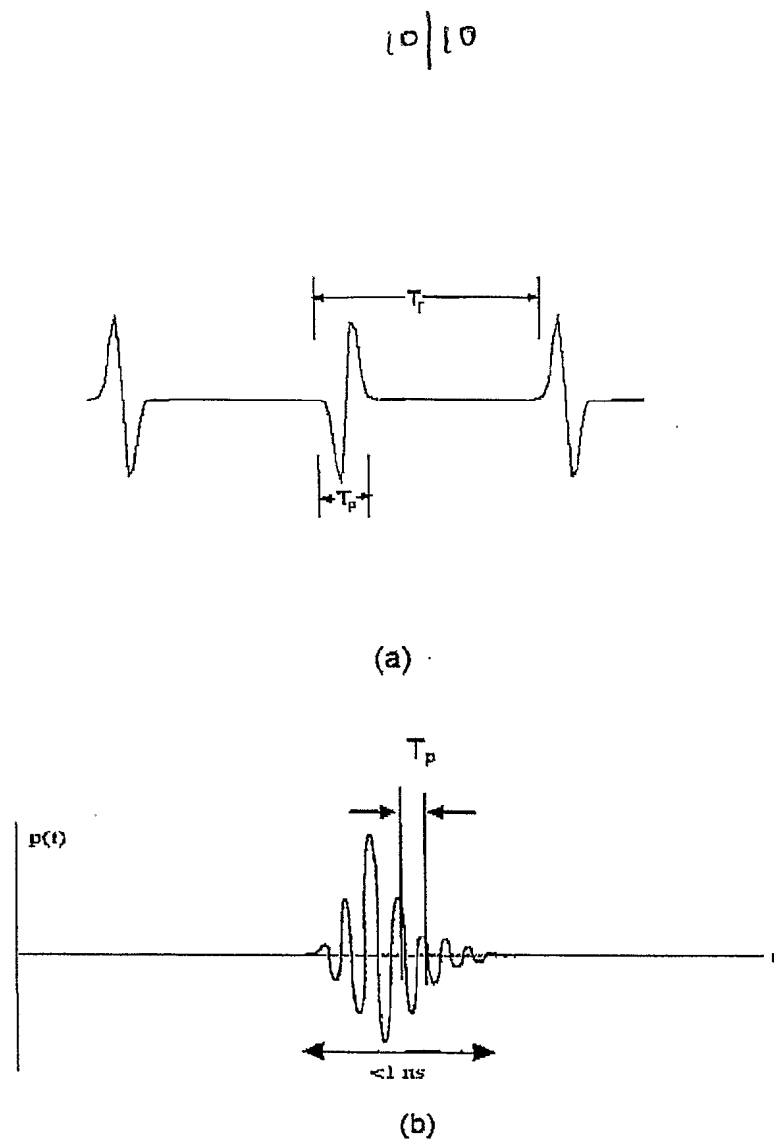
(a)

T_p

p(t)

t

<1 ns

(b)

Fig. 12: Transmitted and received pulse shapes for ultra wideband transmission
(a) Pulse shapes just before transmission, also shows the relation between pulse period (T_p), pulse repetition period (chip period) (T_f).
(b) Typical received pulse for single pulse transmission without channel distortion